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Clinical paper

Survival after in-hospital cardiac arrest is highly associated with the Age-combined Charlson Co-morbidity Index in a cohort study from a two-site Swedish University hospital☆

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ABSTRACT

Background: In-hospital cardiac arrest (IHCA) has a poor prognosis and clinicians often write "Do-Not-Attempt-Resuscitation" (DNAR) orders based on co-morbidities.
Aim: To assess the impact of the Age-combined Charlson Co-morbidity Index (ACCI) on 30-days survival after IHCA.
Material and methods: All patients suffering IHCA at Karolinska University Hospital between 1st January and 31st December 2014 were included. Data regarding patient characteristics, co-morbidities and survival were drawn from the electronic patient records. Co-morbidities were assessed prior to the IHCA as ICD-10 codes according to the ACCI. Differences in survival were assessed with adjusted logistic regression models and presented as Odds Ratios with 95% Confidence Intervals (OR, 95% CI) between patients with an ACCI of 0–4 points versus those with 5–7 points, as well as those with ≥8 points. Adjustments included hospital site, heart rhythm, ECG surveillance, witnessed status and place of IHCA.
Results: In all, 174 patients suffered IHCA, of whom 41 (24%) survived at least 30 days. Patients with an ACCI of 5–7 points had a minor chance and those with an ACCI of ≥8 points had a minimal chance of surviving IHCA compared to those with an ACCI of 0–4 points (adjusted OR 0.10, 95% CI 0.04–0.26 and OR 0.04, 95% CI 0.03–0.42, respectively).
Conclusion: Patients with a moderate or severe burden of ACCI have a minor chance of surviving an IHCA. This information could be used as part of the decision tools during ongoing CPR, and could be an aid for clinicians in planning care and discussing DNAR orders.

Introduction

Sudden cardiac arrest is a common, acute and often fatal condition that constitutes a major challenge to global health care, estimated to affect between 350,000 and 700,000 individuals in Europe yearly.[1] Cardiac arrests that occur within hospitals, i.e. in-hospital cardiac arrests (IHCA) stress certain ethical issues such as awareness and effect of patient co-morbidities, and the exposure of recent medical emergencies.[2] While survival for out of hospital cardiac arrests (OHCA) has steadily increased during the last decade, survival rates for IHCA appear to have remained stagnant at 15–20% for almost 40 years.[2–5] One possible reason for this stagnant trend might be survival counteracting factors, i.e. on one hand a more advanced health care, implementation of rapid response teams as well as constant improvements in CPR training and algorithms[2,6–8] has been developed, but on the other hand, simultaneously patients are both elderly and living longer with single or multiple chronic diseases.[9,10] Therefore, it is essential for physicians to consider a patient's entire burden of co-morbidities while planning care, especially when determining the adequate level of health care in deteriorating patients where an order of Do Not Attempt Resuscitation (DNAR) might be an option.[11] DNAR orders are often based on age and the burden of disease but scientific evidence is sparse and there are very few previous studies on the impact of burden of co-morbidities on survival after IHCA. In addition, only some conditions very common in the hospilitized patient population have been identified as high-risk ones: sepsis, cancer and renal failure.[4,12–14]

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Therefore, we conducted a cohort study with the aim of assessing the association between the Age combined Charlson Co-morbidity Index (ACCI) based on ICD-10 codes known prior to the IHCA and 30-day survival.

Method

Study design and settings

This cohort study took place at Karolinska University Hospital during 2014. Karolinska University Hospital is one of four large hospitals in Stockholm city, home to approximately 2000,000 people. Karolinska University Hospital has two sites, Solna and Huddinge, which are 30 km apart. The Solna site hosts about 750 beds and is a level one trauma unit, has neuro and thoracic surgery units and provides 24/7 angiography for ST-elevation myocardial infarctions. The Huddinge site also hosts about 750 beds and includes a geriatric ward and relatively fewer intensive care unit (ICU) beds. Karolinska University Hospital as a whole has about 108,000 admissions yearly and 1.5 billion patient visits. The Regional Ethical Review Board in Stockholm, Sweden approved the study, DNR 2013/1959-31/4.

Participants

All cases of IHCA occurring between January 1st and December 31th 2014 were eligible for the study and identified through the hospital's cardiac arrest report sheet. The Karolinska University Hospital participates in the Swedish Cardiac Arrest Registry (SCAR)[15] and their definition of IHCA was used, i.e. a hospitalized patient who is unresponsive with apnoea (or agonal, gasping respiration) where CPR and/or defibrillation have been initiated. The inclusion criterion of this particular study was to be aged at least 18 years. No patients were excluded. In the case of multiple IHCA within the same admission, only the first event was included.

Data collection and categorization

Patients were identified through the hospitals cardiac arrest report sheet, where data on the following variables were collected; gender, age (collected in years, categorized in 10-year intervals according to ACCI starting at 18–49, 50–59 and further on to >90 years), place of IHCA (emergency department, patient ward, intermediate care unit, intensive care unit (ICU), angio lab/operation theatre, other area), witnessed or not, pre-arrest ECG-surveillance (yes or no), first documented heart rhythm (VT/VF or PEA/asystole). Thereafter by entering the hospital's electronic patient record (TakeCare version 14.2.9) information on co-morbidities was gathered based on ICD-10 codes available at least at admission to the hospital and assessed according to the ACCI.[16,17] The ACCI was developed in 1984 and has since then been used and cited in over 5 500 articles in various subgroups,[18] it is a summed score assigning severity-weighted points for age and chronic health conditions and is associated with 1-year survival.[19] In order to assess the effect of total burden of disease rather than single diseases, patients were categorized into "Low burden of age-combined co-morbidities" if ACCI was 0–4 points, "Moderate burden of age-combined co-morbidities" if ACCI was 5–7 points or "Severe burden of age-combined co-morbidities" if receiving at least 8 points.[20,21] Information on the outcome, i.e. 30-day survival (yes or no) was retrieved through the electronic patient record which is linked to the Swedish total population registry and automatically updated with a maximum delay of three days which enables a complete follow-up.[22] Information of Cerebral Performance Category (CPC) score at discharge from the hospital was gathered from SCAR and categorized as good (1–2) or poor (3–5).[23]

Statistical analyses

Characteristics of patients surviving at least 30 days and those who were deceased were compared using the two-sided Fishers exact test due to cells with small numbers and set at the significance level of 0.01. Differences between survivors and deceased regarding single diseases were presented purely for descriptive purposes since it might be of clinical interest, but analyses were expected to be underpowered. Logistic regression models were used to estimate the association between category of age-combined co-morbidities (low versus moderate or severe) and 30-day survival, expressed as odds ratios (OR) with 95% confidence intervals (95% CI) with adjustment for known confounders; 1) first documented heart rhythm, 2) ECG-surveillance, 3) witnessed status and 4) place of IHCA 5) hospital site. All analyses were performed with the statistical package STATA 10.2 for Windows (STATA Corp, College Station, TX).

Results

Study participants

In all, 174 patients suffered an IHCA at Karolinska Solna or Huddinge during 2014 and the overall 30-day survival rate was 24%. There was no difference in gender regarding survival (Table 1). The mean age for all patients was 69 years and the majority of survivors were aged below 70 years. Regarding the place of IHCA, survivors more often suffered their IHCA at an intermediate care unit or angio lab/operation theatre, while deceased patients were in patient wards. Regarding witnessed and IHCA during ECG-surveillance no statistically significant difference was found between survivors and deceased (Table 1, p-value 0.02 and 0.04, respectively). Regarding the first documented heart rhythm, half of the survivors had a shockable rhythm, i.e. VT/VF, compared to only 16% of deceased patients (p-value < 0.01). Among the 41 survivors, only 2 (5%) patients had poor CPC at discharge.

Differences in single co-morbidities between survivors and deceased patients

Regarding pre-existing co-morbidities, about a quarter of all patients suffering IHCA had a diagnosis of myocardial infarction, cancer or congestive heart failure (Table 2). Further, pulmonary disease, mainly chronic obstructive pulmonary disease, diabetes without complications and renal disease were present in 14–18% of the total population. The only statistically significant difference in a single diagnosis was cancer, which was less common among survivors than deceased patients (2% versus 31%, p-value < 0.01, Table 2).

Association between age-combined co-morbidity index and survival

In all, 68 (39%) of the patients had low burden of age-combined co-morbidities, 83 (48%) had a moderate burden of age-combined co-morbidities and 23 (13%) had a severe burden of age-combined co-morbidities prior to the IHCA (Table 3). Patients with a moderate burden of age-combined co-morbidities had a far lower chance of surviving IHCA compared to those with low burden of age-combined co-morbidities (crude OR 0.17, 95% CI 0.06–0.47, as well as adjusted OR 0.10, 95% CI 0.04–0.26, Table 3). Patients with severe burden of age-combined co-morbidities had a minor chance of surviving IHCA compared to those with low burden of age-combined co-morbidities (crude OR 0.23, 95% CI 0.05–1.13, as well as adjusted 0.04, 95% CI 0.03–0.47, Table 3).